Research Note

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SNOW DAMAGE IN A POLE STAND OF WESTERN WHITE PINE

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Records of mortality in dense young western white pine stands show snow to be the most important cause of mortality over a period of years 1/, but do not indicate the extremely heavy losses which may be experienced during a single winter. The heavy damage which occurred in northern Idaho during the winter of 1948-49 offered an opportunity to measure the near-catastrophic losses which may occur during one winter. This report of heavy losses in a pole stand on the Deception Creek Experimental Forest adds to our understanding of mortality in the western white pine type.

Observations on a two-acre permanent sample plot, No. 14, located in a severely damaged stand in the Deception Creek Experimental Forest revealed the extent and nature of the snow damage. This plot had been remeasured periodically since its establishment in 1923. Because Plot 14 had been measured in the fall of 1948, the winter losses were accurately determined by measuring the plot again in 1949. Besides the 1949 observations on Plot 14, injury data were collected on 17 tenth-acre temporary sample plots in the surrounding pole stand to determine the loss over a larger area. The stand studied was well stocked and, since the establishment of Plot 14 in 1923, had made good growth. The plot is situated at an elevation of 4300 feet on a fair site -- site index 49 feet at 50 years. When the plot was established in 1923 the stand age was 55 years.

RESULTS

Although there were other effects which will be described, the most important result of the winter's damage was a reduction of volume and growing stock on the area. On Plot 14, thirty percent of the cubic volume, 37 percent of the trees, and 32 percent of the basal area were lost. Table 1 shows the number of trees, basal area, and cubic volume per acre, and the

1/ Haig, I. T., Davis, K. P., and Weidman, R. H. Natural regeneration in the western white pine type. U.S.D.A. Tech. Bul. 767. 1941.

basal area normality of the plot from 1923 to 1949. The basal area in 1949 was considerably less than that on the plot at its establishment 26 years earlier. Evidently losses on the permanent plot were somewhat greater than the average for the surrounding stand because the 17 tenth-acre temporary plots showed a loss in trees of only 21 percent.

Table 1.--Stocking of Plot 14 at different dates.

Date	Number of trees	Basal area	Cubic volume	Basal area normality 1/
	Number	Sq. ft.	Cubic feet	Percent
1923	1148	188	3848	93
1928	1012	194	4417	89
1933	946	207	5228	90
1938	774	204	5431	85
(Before 1948-49 winter damage)				
1948	588	220	7085	85
(After 1948-49 winter damage)				
1949	368	150	4973	58

1/ Comparison of basal area stocking with that given in the yield tables for western white pine. Haig, I. T. Second-growth yield, stand and volume tables for the western white pine type. U.S.D.A. Tech. Bul. 323. 1932

The smaller trees on Plot 14 were more heavily damaged than the larger ones. Forty-one percent of all trees smaller than nine inches were killed, but only 31 percent of the trees nine inches and larger.

All species were damaged about equally. Species composition on Plot 14 was changed only slightly by the winter's damage; in fact, since establishment of the plot in 1923, the change in stand composition has been small. Table 2 shows the species composition, by cubic volume, of Plot 14. By way of comparison, the additional samples taken in the adjacent stand indicated a slight reduction in the proportion of white pine and a slight gain in the proportion of grand fir.

Table 2.--Cubic-foot composition of stand on Plot 14 in percent.

Date	Western white pine	Grand fir	Western hemlock	Others 1/	All species
			Total stand		
1923	64	26	5	5	100
1928	63	27	6	4	100
1933	63	28	6	3	100
1938	63	26	7	4	100
1948	63	27	7	3	100
1949	65	25	7	3	100
			Dominant stand		
1923	73	17	4	6	100
1928	73	18	5	4	100
1933	71	20	6	3	100
1938	71	19	6	4	100
1948	70	21	6	3	100
1949	70	20	6	4	100

1/ Includes western larch, Douglas-fir, lodgepole pine, Engelmann spruce, and alpine fir.

Breaking of the bole caused more mortality than uprooting. On Plot 14, 61 percent of all fatal injuries were caused by breaking of the bole and only 39 percent by uprooting. Samples in the adjacent stand showed similar results -- 65 percent by breaking and 35 percent by uprooting.

DISCUSSION

Unusually heavy losses of the kind which have been described are due to a combination of climatic conditions. Wet snow, followed by freezing temperatures, solidifies upon the foliage forming a heavy mass which will hold subsequent snowfalls. Bending, breaking, and uprooting follow. Winds which might otherwise cause little damage may be very destructive to trees heavily laden with snow and ice.

Direct mortality, although the most important effect of snow damage, is not the only one. The indirect consequences of the winter's damage are undoubtedly serious but difficult to assess. The vigor of the surviving trees may be reduced by the sudden and drastic change in the microclimate. Loss of foliage not great enough to cause death may reduce the growth rate and

lower the vigor of the trees. Compression failures in the bole may have occurred which will not be discovered until the trees are manufactured into lumber. The added fuels and the more open stand conditions may make fire protection more difficult. Future remeasurements of this plot may reveal additional injury which was not apparent in 1949.

Earlier observers reported that in some instances the effects of snow injury are comparable to a heavy crude thinning. 2/ Crooked, small, and weakly-rooted trees tend to be more heavily damaged than the better formed, larger, and stronger ones. However, damage is often spotty and creates small openings which serve as foci for further damage in succeeding years. The present study showed that snow damage can reduce the growing stock below that required for good growth.

The findings from the study tended to confirm another investigation of growth in white pine stands in which mortality was found to be erratic on small areas. 3/ Evidently, much of the mortality in natural stands occurs irregularly. It is not like growth which accrues rather evenly. The erratic nature of mortality increases the difficulty of predicting net growth on small areas.

2/ Cited in footnote 1.

3/ Watt, Richard F. Growth in understocked and overstocked western white pine stands. Northern Rocky Mountain Forest and Range Experiment Station Research Note No. 78. 1950.